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(54) **Injection molding a double-layer preform**

(57) Apparatus for injection molding a double-layer preform comprises first and second molds (29 and 30) and two injection molding cores (31) engageable therein. In use, a neck mold (17) is brought into engagement with the second mold (30) and the cores (31) are brought into engagement with their respective molds (29 and 30) to define a first cavity in mold (29) for forming an inner layer of the preform and a second cavity in mold (30) for forming an outer layer over the entire surface of a previously molded inner layer of a preform. When the outer layer has been formed in the second mold (30) and the cores (31) withdrawn, the neck mold (17) carries the double layer preform to a stretch-blow molding stage and a plate (33) carrying the injection cores (31) is rotated to bring the core (31) carrying an inner preform layer formed in the first mold (29) into alignment with the second mold (30) for formation of the outer layer thereof.

FIG.2

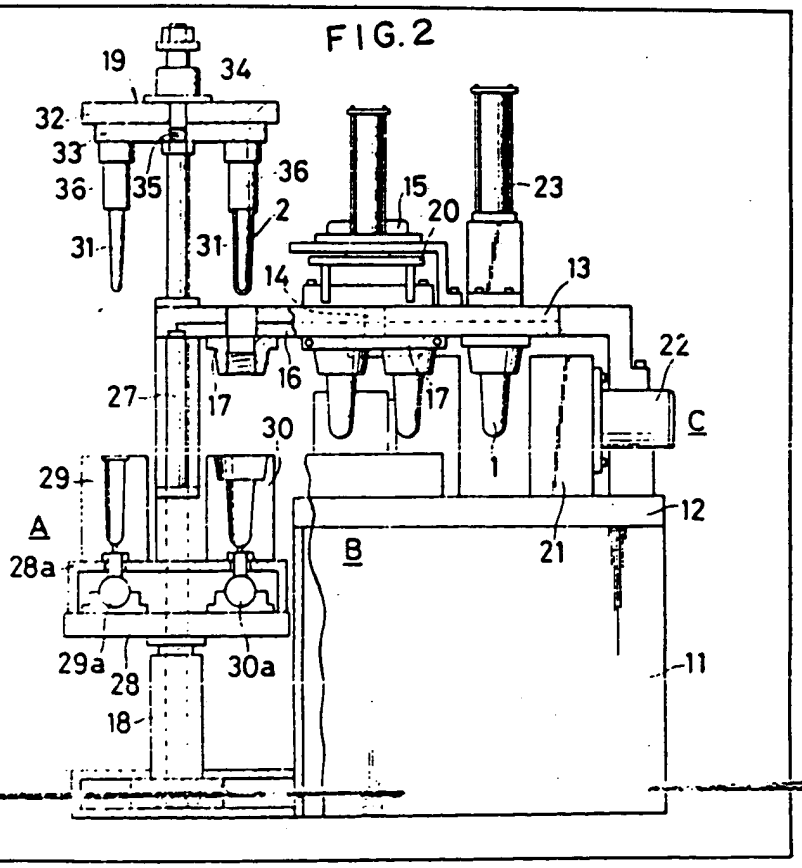

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FIG. 1

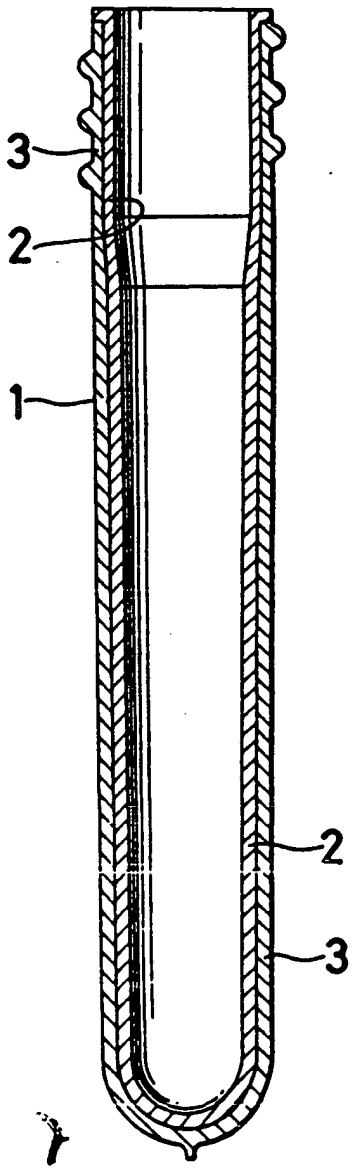

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FIG. 2

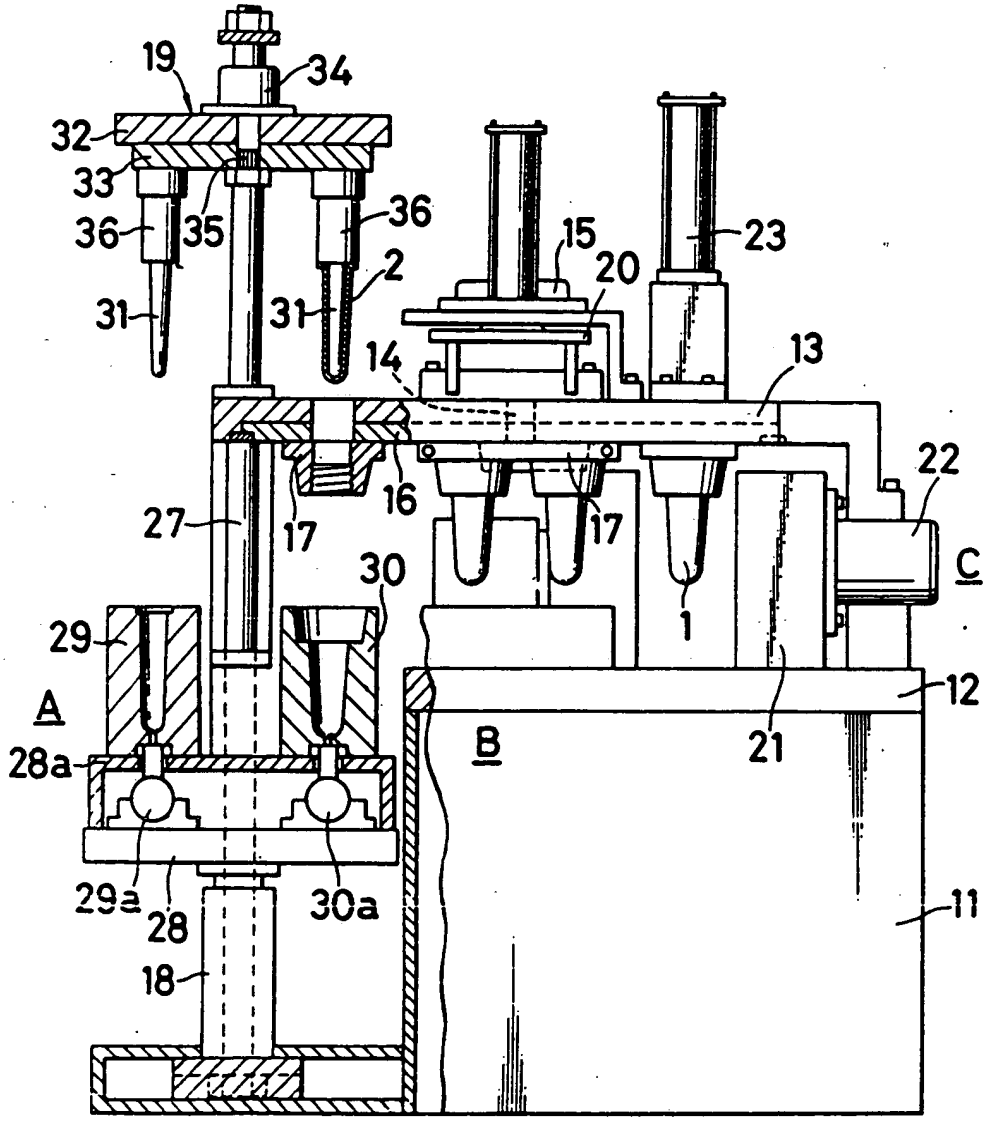

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FIG. 3

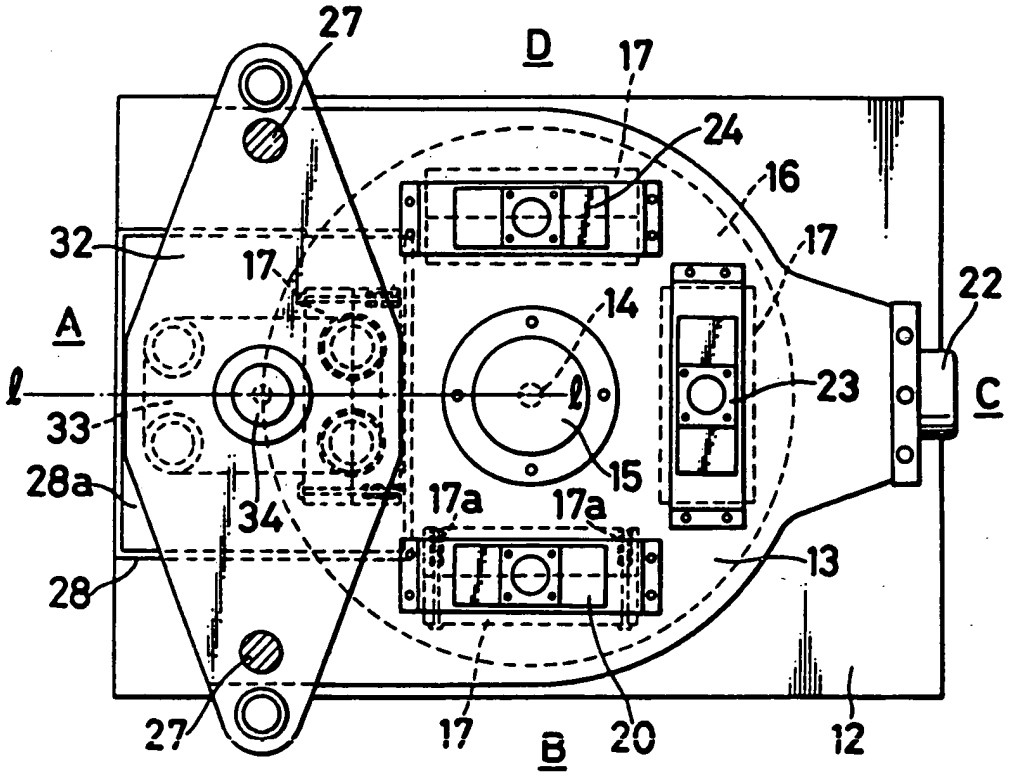

FIG. 4

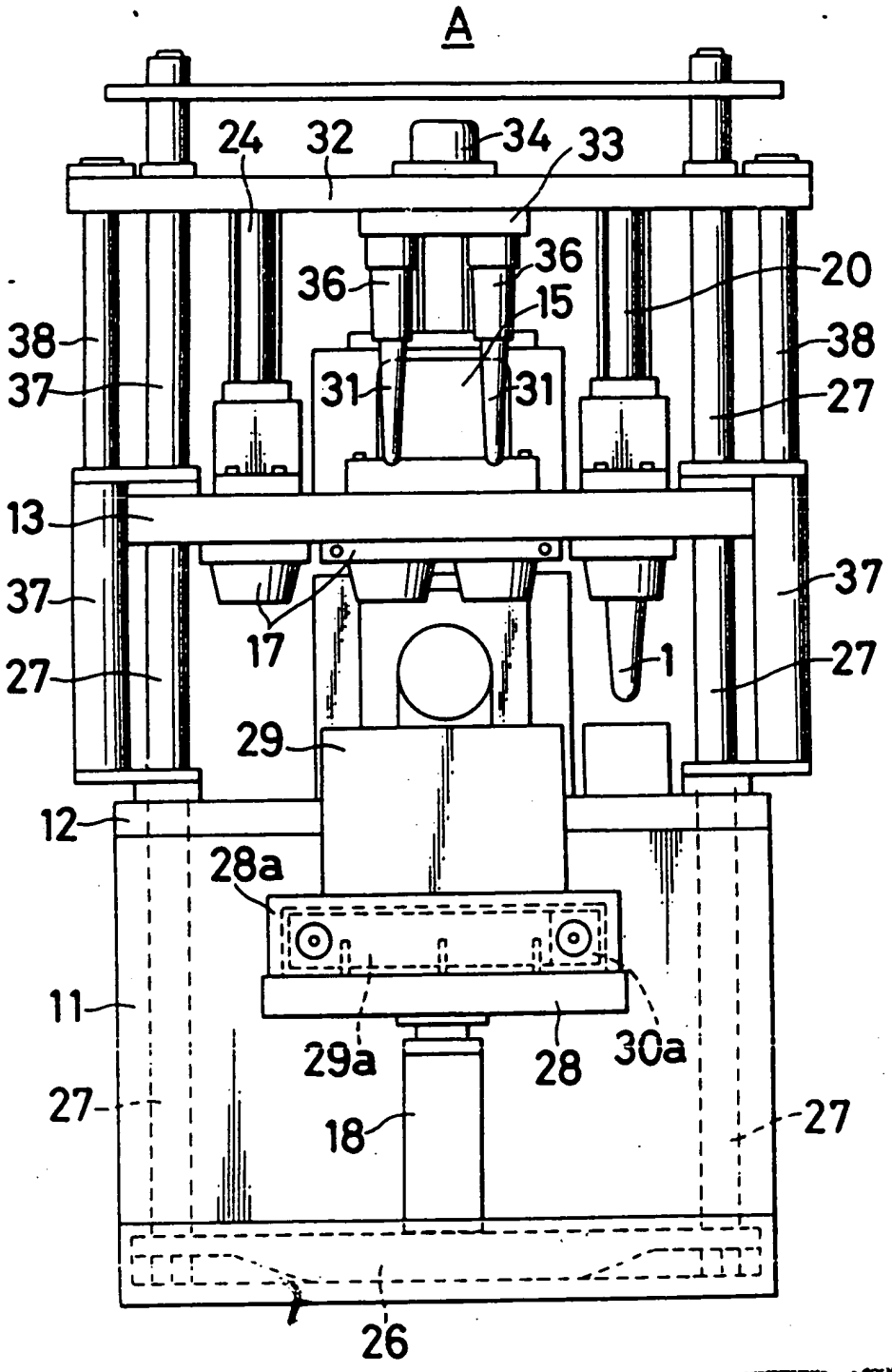
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FIG.5

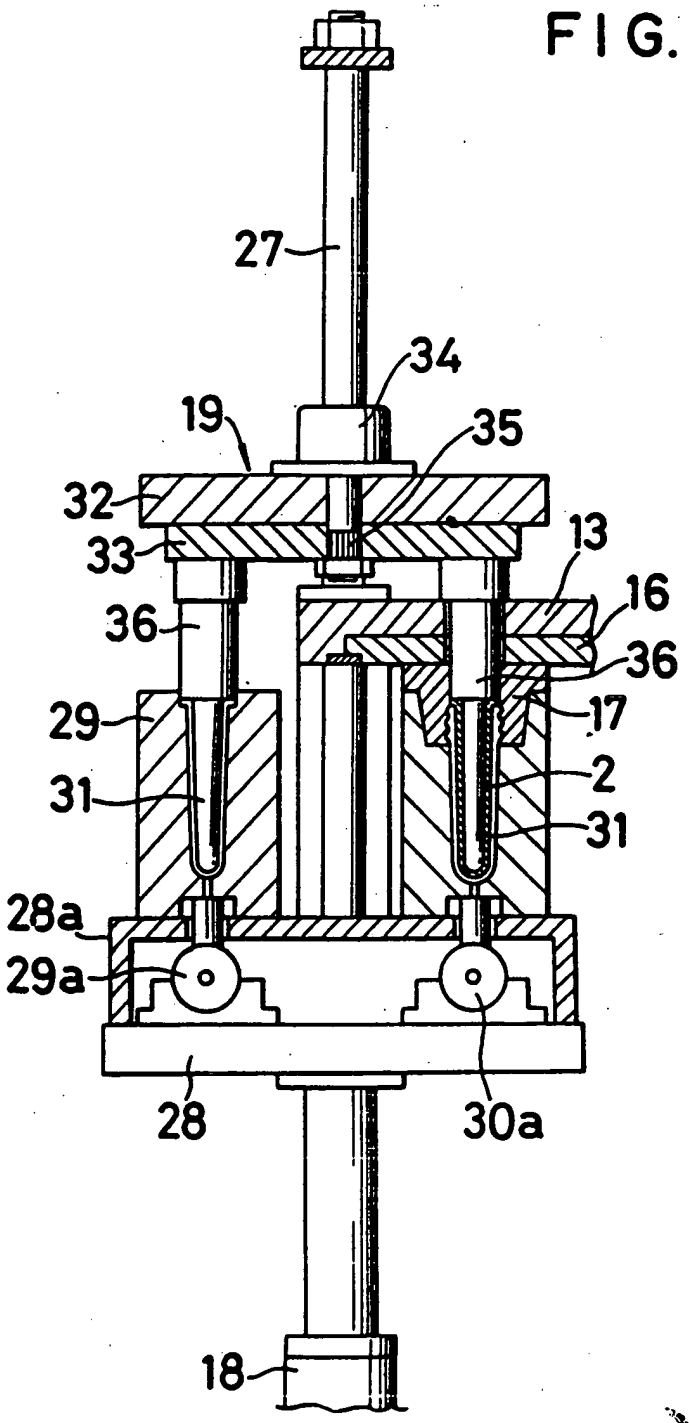

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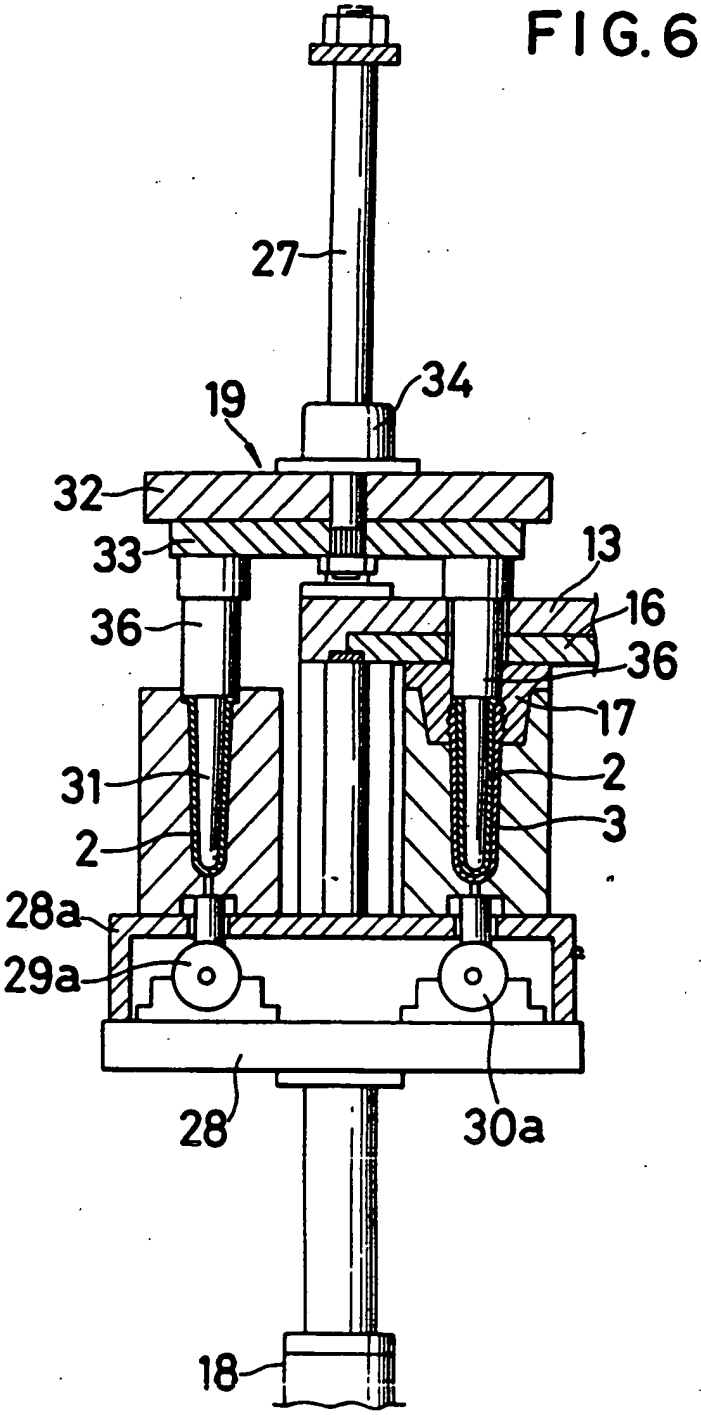
FIG.6



SPECIFICATION

Apparatus for and a method of injection molding a double layer preform

This invention relates to an apparatus for and a method of injection molding a double layer preform.

The necessity for double-layered containers such as bottles for beverages is increasing with the wide use of synthetic resin containers. If the neck portion is formed by the inner layer alone and even if the outer layer is formed of polycarbonate of excellent heat resistance, the neck portion may undergo thermal deformation at the time of filling impairing the seal of the lip portions, so that the container cannot perform its function. Such deformation is particularly likely in the case of double-layered containers having an inner layer formed of polyethylene-terephtalate which is liable to give rise to thermal deformation when a filing temperature for the content of the container exceeds 80°C. However, if the neck portion is formed by both the inner and outer layers, deformation of the neck portion can be prevented by the polycarbonate forming the outer layer.

U.S. Patent No. 4,105,391 discloses molding apparatus wherein a plurality of neck molds are mounted at given intervals on the undersurface of a transferring platen provided above the machine base. In use of the apparatus the neck molds and corresponding injection molds are closed, injection cores are inserted into the molds and molten resin is injected through the neck molds to mold a preform with a bottom around the injection cores. Thereafter the injection cores are removed and the injection molds opened to enable the injection cores to be transferred together with the neck molds and the preform carried thereby, to the next step. If the injection molding stage is expanded to include two neck molds and corresponding injection molds as described in U.S. Patent No. 4,321,029, the inner layer and the outer layer of double-layer preform can be injection molded continuously and the double-layered preform can be transported to the next step in the process without modification to the remainder of the apparatus.

However, in the apparatus which transfers the preform while being held by the neck mold, the molten resin is poured into the neck mold to mold the inner layer of the preform first. Therefore, in the next step of molding the outer layer preform, a space for receiving molten resin cannot be formed between the neck mold and the inner layer preform without modification of the apparatus, and the outer layer preform molded therein is formed only by the injection mold. This arrangement does not, therefore, allow a double-layered preform to be formed which has both an inner layer and an outer layer right up to the neck portion of the preform, as shown in Figure 1 of the accompanying drawings.

It is an object of the present invention to provide a way of molding a double-layer preform which overcomes or at least mitigates the above mentioned problems.

According to one aspect of the present invention, there is provided a method of injection molding a double layer preform, comprising: moving an injection molding member into engagement with a first mold to define therebetween a first cavity; introducing molten resin into the first cavity to form an inner layer of a preform on the injection molding member; moving the injection molding member carrying the preform inner layer into engagement with a second mold having a neck mold associated therewith to define a second cavity bounded by the preform inner layer, the second mold and the neck mold; and introducing molten resin into the second cavity to form an outer layer of the preform extending over substantially the entire inner layer thereof.

According to a second aspect of the present invention, there is provided apparatus for injection molding a double layer preform for use in a molding machine, comprising: first and second molds; an injection molding member engageable with the first and second molds; and means for moving the injection molding member whereby, in use, the injection molding member is first brought into engagement with the first mold to define therebetween a first cavity for forming an inner layer of a preform and, when the inner layer of the preform has been formed, the injection molding member, carrying the preform inner layer, is brought into engagement with the second mold to define a second cavity for forming an outer layer of the preform, the second cavity being bounded by the preform inner layer, the second mold and a neck mold associated with the second mold so that when the outer layer of the preform is formed it extends over the entire inner layer thereof.

In a third aspect, the present invention provides apparatus for injection molding a double layer preform for use in an injection molding stage of a molding machine wherein a plurality of neck molds, which also serve to hold preforms and molded articles, are mounted at given intervals on the undersurface of a transfer platen which is intermittently rotatable to bring the neck molds successively into association with an injection molding stage and a stretch blow molding stage, the apparatus comprising: clamping devices provided beneath and outside a transferring platen on the side of a machine base at a stopping position of the neck molds corresponding to the injection molding stage of the molding machine; a first mold disposed outside of the transferring platen and closable by an injection molding core to define a cavity for molding an inner layer of a preform; a second mold associated with a neck mold and closable by a further injection molding core to form a cavity for molding an outer layer preform over the entire circumference of the inner layer preform, the first and second molds being arranged parallel to one another on a clamping plate of the clamping device; an injection molding core clamping means comprising a rotary plate and a lifting plate for alternately inserting the

injection molding cores into the first and second molds; and a rotating and driving device disposed above the first and second molds.

In a preferred embodiment, the clamping devices provided with the first and second molds and the core mold clamping device are opened and closed when the transfer platen stops during the time a neck mold is positioned at the injection molding stage, and movement of the injection molding cores relative to the two sets of molds is effected in synchronism with the rotation of the transferring platen. Thus, in order to mold a double-layered preform in association with intermittent movement, it is necessary simultaneously to mold an inner layer parison and an outer layer parison, and therefore, at least a pair of injection molding cores of the same shape are mounted on the core mold clamping device. The injection molding cores which each have a length sufficient to mold both inner and outer layers up to a lip portion of the preform, project from the lower surface of a member in order to close the first mold and neck mold. Thus, a double-layered preform can be molded up to the lip portion in a manner similar to that in which a single layer preform is injection molded. In addition, the molding machine need not be modified other than in the injection molding stage and no considerable delay occurs even in the molding cycle. Moreover, if required, a single layer preform having a wall-thickness equivalent to that of a double layer preform can be formed by arranging for an injection molding core not carrying a preform inner layer to be inserted in the second mold.

Furthermore, in the preferred embodiment, the first mold is provided parallel to and outside the second mold and a core clamping device provided with the injection molding cores can be merely disposed above the molds, so that the construction and operation are not particularly complicated and the basic construction of the existing molding machine need not be substantially changed.

For a better understanding of the present invention, and to show how the same may be put into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view of a double-layered preform injection molded by apparatus for molding double-layered preforms in accordance with the present invention;

Figure 2 is a side view of molding machine with an injection molding stage shown in longitudinal section;

Figure 3 is a plan view of the molding machine of Figure 2;

Figure 4 is a front view of the injection molding stage of the molding machine;

Figure 5 is a longitudinal sectional side view of the injection molding stage with the molds therefor closed; and

Figure 6 is a longitudinal sectional side view of the injection molding stage, showing an inner layer preform and a double-layered preform being simultaneously injection-molded.

Referring now to the drawings and in particular Figures 2 to 6, a molding machine comprises a lower base platen 12 on a machine base 11 and an upper base platen 13 provided at a predetermined distance above the lower base platen 12. The space between the base platens 12 and 13 is the molding space.

A circular transferring platen 16 is disposed at the under-surface of the upper base platen 13 and is intermittently rotated through respective angles of 90° around a central support shaft 14 by means of a hydraulically or electrically-operated motor 15. Five neck molds 17 closed by springs 17a are disposed on the undersurface of the transferring platen 16 equidistant from one another. The neck molds 17 are arranged so that they open and close radially of the platen 16. Thus, when the platen 16 is rotated by the motor 15, each neck mold 17 first at a preform injection molding stage A, then at a heating stage B, next at a stretch blow molding stage C, and finally at a mold releasing stage D.

A hydraulically operated mold clamping device 18 and a core mold clamping device 19 are vertically arranged at the injection-molding stage A, while a device 20 is provided at the heating stage B to heat or cool the preform to control a preform temperature to be at the stretching and blow temperature.

In the stretching and blow molding stage C, a blowing mold 21 which is arranged to open and close radially of the platens under oil pressure and a hydraulic actuating device 22 for opening and closing the blowing mold 21 are provided on the lower base platen 12. A lifting device 23 for a moving a stretching and blowing rod is provided on the upper base platen 13. At the mold releasing stage D, a device 24 for pushing open the neck molds 17 against the springs 17a is provided.

The above-described devices are opened and closed or moved up and down, as appropriate, when the transferring platen 16 and each of the neck molds 17 stops at a predetermined position.

The mold clamping device 18 is provided to extend both beneath and beyond the transferring platen 16 on the line I—I of Figure 3 which connects the centre of rotation of the transferring platen 16 and the centre of the neck molds 17.

Connected to a fixed plate 26 on the side of the machine base on which the mold clamping device 18 is mounted are a pair of tie-rods 27 which serve to hold the upper base platen 13 and to support the upper core mold clamping device 19. A mold place bed 28a having formed therein two sets of hot runner blocks 29a, 30a is provided on the mold clamping plate 28. Two sets of molds 29, 30 are mounted parallel to one another on the mold place 28a. A first one of the molds 29 is positioned externally of, that is, beneath but spaced outwardly from, the transferring platen 16 and the second mold 30 is mounted at a position [illegible] have cavities in the same number as the number of neck molds 17. The cavity of the first mold 29 is

large enough to mold an inner layer preform 2 between it and the injection core 31 inserted into the mold. The cavity of the second mold 30 is of sufficient size to form a space for receiving an injection molding core 31 along with an inner layer preform 2 adhered to the periphery of the core so that an outer layer preform 2 (Figure 1) can be formed between the wall of the cavity and the inner layer preform 2, the cavity of the mold 30 being connected to the space formed between the neck mold 17 and the inner layer preform 2.

Movement of the injection cores 31 relative to the two sets of molds 29 and 20 is effected by a rotatable plate 33 provided on the underside of the lifting plate 32 which is supported on the tie-rods 27. A rotating and driving device 34 such as a rotary actuator on the molding clamping plate is provided to rotate the plate 33 via a drive transmission shaft 35. The injection molding cores 31 project from the lower ends of mold beds 36 provided a diametrically opposed positions on the lower surface of the plate 33 connected to the shaft 35. Movement of the lifting plate 32 towards and away from the molds 29 and 30 is effected by a hydraulic arrangement, the pistons 38 of hydraulic cylinders 37, 37 being mounted adjacent the tie-rods 27 on which the plate 32 is slidable.

The molding of a double-layered preform 1 by the above-described apparatus can be carried out in a manner similar to the case where a single layer preform is to be molded. Thus, when the transfer platen 16 stops and one of the neck molds 17 is positioned at the injection molding stage A, the first mold 29 and second mold 30 are moved toward the base platen 13 by the operation of the mold clamping device 18 to bring the neck mold 17 and the second mold 30 into engagement.

Next, the mold clamping plate 32, and therefore the injection molding cores 31 are moved downwards by the operation of the core mold clamping device 19 so that a respective injection molding core is inserted into each of the first and second molds 29 and 30, the arrangement being such that the first mold 29 and neck mold 17 are contacted and thereby closed by respective mold beds 36. At this stage, an inner layer 2 of the preform (which is previously formed in the first mold 29) carried on the periphery of one of the injection molding cores 31, is positioned within the second mold 30 so as to extend through the neck mold 17, as shown in Figure 5.

When the molds have been clamped in the closed position shown in Figure 5, molten resin is supplied to both the first and second molds 29 and 30 from an injection device (not shown) via respective nozzles [illegible] such communicating with the hot runner blocks 29a and 30a, respectively.

Thus the inner layer 2 of a preform is molded onto the periphery of the injection molding core [illegible] preform is formed on the periphery of the inner layer 2 of preform carried by the injection molding core clamped in the second mold 30. As shown in Figure 6, the outer layer 3 of the preform extends along the whole length, including the neck portion, of the preform because the cavity formed by the neck mold 17 communicates with the mold cavity formed by the second mold 30.

After the preform has been injection molded, the mold clamping device 18 and the core mold clamping device 19 are operated to open both the molds 29 and 30 and to raise the injection cores 31. An inner layer preform 2 adhered to the periphery of the corresponding injection molding core 31 is removed from the first mold 29, while only the injection molding core 31 is removed from the second mold 30 so that the molded double-layered preform 1 is held in the neck mold 17 in the hollow state.

When the injection cores are returned to their original raised position by the upper mold clamping device 19 and the molds 29 and 30 are returned to their lowered position by the lower mold clamping device 18, the transfer platen 16 is rotated, and the double-layered preform 1 held by the neck mold 17 is moved onto the heating stage B. The rotating and driving device 34 is operated at substantially the same time as the rotation of the transfer platen 16, and the plate 33 is rotated through an angle of 180° to return the injection molding cores 31, 31 to the positions shown in Figure 2. When the transferring platen 16 stops again and the neck mold 17 is positioned, the molding of an inner layer preform 2 and molding of a double-layered preform 1 are again simultaneously performed.

It should be noted that the stretch-blow molding and mold releasing stage are of a conventional type and that these stages of the process to produce a finished container are carried out in the normal way.

While in the arrangement described above, the molding machine is provided with a heating stage B, it should be noted that where the stretch blow molding operation can be carried out without heating, the heating stage can be dispensed with. The inner layer 2 of the preform and the outer layer 3 can, of course, be molded from either the same or different resins, and no limitation in the resins used is made in the arrangement described above.

CLAIMS

1. A method of injection molding a double layer preform, comprising: moving an injection molding member into engagement witha first mold to define therebetween a first cavity; introducing molten resin into the first cavity to form an inner layer of a preform on the injection molding member; moving the injection molding member carrying the preform inner layer into engagement with a second mold having a neck mold associated therewith to define a second cavity bounded by the preform inner layer, the second mold and the neck mold; and introducing molten resin into the second cavity to form an outer layer of the preform extending over all substantially the

entire inner layer thereof.

2. A method according to Claim 1, further comprising bringing a further injection molding member into engagement with the first cavity to form an inner layer of a preform on the further injection molding member when the injection molding member carrying the preform inner layer is brought into engagement with the second mold.

3. A method according to Claim 1 or 2, further comprising bringing the injection molding member out of contact with the second mold when the outer layer of the preform has been formed and moving the neck mold carrying the double layer preform into a further processing stage.

4. A method according to claim 3 when dependent on claim 2, further comprising moving a further neck mold into association with the second mold when the neck mold carrying the previously formed double layer preform is moved onto a further processing stage and moving the injection molding member and the further injection molding member to bring the injection molding member into engagement with the first mold and to bring the further injection molding member carrying the previously formed preform inner layer into engagement with the second mold having the further neck mold associated therewith.

5. A method of injection molding a double layer parison substantially as hereinbefore described with reference to the accompanying drawings.

6. A method of forming a container whenever incorporating a method in accordance with any one of claims 1 to 5.

7. Apparatus for injection molding a double layer preform for use in a molding machine, comprising: first and second molds; an injection molding member engageable with the first and second molds; and means for moving the injection molding member whereby, in use, the injection molding member is first brought into engagement with the first mold to define therebetween a first cavity for forming an inner layer of a preform and, when the inner layer of the preform has been formed, the injection molding member, carrying the preform inner layer, is brought into engagement with the second mold to define a second cavity for forming an outer layer of the preform, the second cavity being bounded by the preform inner layer, the second mold and a neck mold associated with the second mold so that when the outer layer of the preform is formed it extends over the entire inner layer thereof.

8. Apparatus according to Claim 7, wherein a further injection molding member engageable with the first and second molds is provided, the arrangement being such that the further injection molding member engages the first mold when the injection molding member engages the second mold.

9. Apparatus according to Claim 8, wherein the injection molding member and the further injection molding member are carried by a rotatable member so that, when the rotatable member is rotated, the injection molding member is brought into engagement with one of the first and second molds and the further injection molding member is brought into engagement with the other of the first and second molds.

10. Apparatus according to Claim 7, 8 or 9, wherein means are provided for moving the neck mold carrying the formed double-layer preform onto a further processing stage after the outer layer thereof has been formed and for moving a further neck mold into association with the second mold.

11. Apparatus according to Claim 10, wherein the neck mold moving means comprises a rotatable member carrying a plurality of neck molds and means for intermittently rotating the neck mold rotatable member to bring each neck mold in succession into association with the second mold.

12. Apparatus for injection molding a double layer preform for use in an injection molding stage of a molding machine wherein a plurality of neck molds which also serve to hold preforms and molded articles are mounted at given intervals on the undersurface of a transfer platen which is intermittently rotatable to bring the neck molds successively into association with an injection molding stage and a stretch blow molding stage, the apparatus comprising: clamping devices provided beneath and outside a transferring platen on the side of a machine base at a stopping position of the neck molds corresponding to the injection molding stage of the molding machine; a first mold disposed outside the transferring platen and closable by an injection molding core to define a cavity for molding an inner layer of a preform; a second mold associated with a neck mold and closable by a further injection molding core to form a cavity for molding an outer layer preform over the entire circumference of the inner layer preform, the first and second molds being arranged parallel to one another on a clamping plate of the clamping device; an injection molding core clamping means comprising a rotary plate and a lifting plate for alternately inserting the injection molding cores into the first and second molds; and a rotating and driving device disposed above the first and second molds.

13. Apparatus according to Claim 12, wherein the mold clamping plate and the lifting plate are provided on two tie-rods provided on opposite sides of the injection molding stage extending through the upper base platen, and a rotating and driving device having a rotary shaft connected to the rotary plate is mounted on the central portion of the upper surface of the lifting plate, the injection molding cores being positioned on mold beds at diametrically opposed positions on the lower surface of the rotary plate.

14. Apparatus according to Claim 12 or 13, wherein the rotating and driving device comprises a hydraulically or electrically-operated motor.

15. Apparatus according to any one of Claims 7 to 14, wherein the first and second molds are provided with the same number of cavities of the same number as the number of neck molds, each

cavity of the first mold having a size sufficient to allow the inner layer of a preform to be molded between the cavity wall and the injection molding core or member inserted into the mold while each cavity of the second mold is arranged to receive an injection molding core or member together with the inner layer preform formed thereon to form a space for molding the outer layer preform between the cavity wall and the inner layer of the preform, the said space having a size sufficient to provide a connecting passage between the neck mold and the inner layer of the preform.

16. Apparatus for injection molding a double layer preform for use in a molding machine substantially as hereinbefore described with reference, to and as illustrated in, the accompanying drawings.

17. An injection and stretch-blow molding machine whenever incorporating apparatus in accordance with any of Claims 7 to 15.

18. An injection and stretch-blow molding machine substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

19. A preform wherever formed using a method in accordance with any one of Claims 1 to 6 and/or apparatus in accordance with any one of Claims 7 to 18.

20. A container whenever formed from a preform in accordance with Claim 19.

21. Any novel feature or combination of features described herein.

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